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REMARKS

The Office Action of June 16, 2005 was received and reviewed. Applicants would like to thank the Examiner for the consideration given to the above-identified application.

Claims 1-3 and 6-14 and 19-48 were pending prior to the instant amendment. By this amendment, claims 1, 2, 3, 13 and 14 are amended. Claims 4-5 and 15-18 have been cancelled previously. Consequently, claims 1-3, 6-14 and 19-48 are currently pending in the instant application, of which claims 1-3, 13 and 14 are independent.

Referring now to the detailed Office Action, claims 1-3, 6-14, 19-43 stand rejected under 35 U.S.C. §103(a) as unpatentable over Yamazaki (U.S. Patent 4,727,044 – hereafter Yamazaki) in view of Silver (U.S. Patent 5,104,818 – hereafter Silver) and further in view of Chang (U.S. Patent 5,064,775 – hereafter Chang), Zhang et al. (U.S. Patent 5,904,509 – hereafter Zhang et al.) and Miyasaka (U.S. Patent 6,455,360 – hereafter Miyasaka). Further, claims 44-48 stand rejected under 35 U.S.C. §103(a) as unpatentable over Yamazaki in view of Silver and further in view of Chang and further in view of Zhang et al., Miyasaka and Wolf et al. (“Silicon Processing for the VLSI Era Volume 1: Process Technology” – hereafter Wolf et al.). Each of these rejections is traversed for the reasons advanced in detail below.

Initially, Applicants respectfully note that the pending claims are again rejected for based on the identical reasoning as detailed in the Office Action mailed June 16, 2005. That is, the §103(a) rejections in the Office Action mailed October 26, 2005 are verbatim of the prior art rejection in Office Action mailed June 16, 2005. The Examiner reasoned that the arguments submitted in the Amendment filed September 16, 2006 was not persuasive because the fact that Applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. The Examiner further reasoned that no unexpected results have been shown with respect to the claimed features.

In response, the Examiner is reminded that to establish a *prima facie* case of obviousness, there must be (1) some suggestion or motivation (either in the references themselves or in the knowledge generally available to one of ordinary skill in the art) to modify the reference or to combine reference teachings to achieve the claimed invention and (2) the prior art must teach or suggest all the claim limitations. MPEP §2143. Also, simply

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because the references could be does not mean that they should be. MPEP §2143.01, In re Mills, 16 USPQ2d 1430 (Fed. Cir. 1990).

In the Amendment filed September 16, 2005, Applicants argued that a *prima facie* case of obviousness has not been established by presenting detailed reasoning that there is no motivation or suggestion to combine the cited references. By failing to consider Applicants' arguments and by asserting that "Applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious", the Examiner failed to follow MPEP §2143 in making a *prima facie* case of obviousness rejection.

Further, the Examiner is respectfully requested to show where in the MPEP that requires Applicants to show unexpected results with respect to the claimed features. That is, in order to make the allegation that no unexpected results have been shown, there must be clear basis and sound reasoning, rather than making a catch all statement. Further, without establishing a *prima facie* case in the rejection, such secondary consideration requiring unexpected result with respect to the claimed features is not proper, especially when no specific claimed features and no ground on which "unexpected results have been shown" is based have been given.

If the Examiner still alleges that unexpected results were not shown, Applicants would respectfully request the Examiner to review Applicants' detailed explanation of the presently claimed invention in the Amendment filed September 16, 2005, wherein unexpected results have been clearly established. The arguments submitted in the earlier filed Amendment are incorporate herein by reference.

Further, although the original specification and the current prosecution history of this case are deemed sufficient in establishing unexpected results with respect to the claimed features, should filing an affidavit be necessary, Applicants would prepare and submit a statement referencing the unexpected results of the presently claimed invention.

Turning now to the prior art rejections, before traversing, Applicants' would like to summarize the cited prior art references as follows.

Yamazaki discloses, among other features, a semiconductor film having an amorphous silicon structure over a substrate; crystallizing the semiconductor film; and, a

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concentration of carbon, nitrogen, oxygen are present in an amount less than 5×10^{16} atoms/cm³.

Silver discloses, among other features, implantation of the channel region.

Chang discloses, among other features, implantation of Boron dopant into a polysilicon film.

The Zhang et al. reference discloses forming a source region and a drain region by plasma doping without mass separation of ions.

Miyasaka discloses forming a source region and a drain region by ion doping without mass separation using hydrogenated species of the impurity ions which are diluted in hydrogen to concentrations of about 0.1 to 10%.

In the pending rejections, the Examiner alleged that it would have been obvious that the process of Yamazaki modified by Silver and Chang to be further modified by Zhang et al., since plasma doping is shown to be suitable method of injecting ions into a semiconductor. Additionally, the Examiner alleged that it would have been obvious that the process of Yamazaki modified by Silver, Chang, and Zhang to be modified by Zhang et al. because Miyasaka shows this to be a suitable combination to form doped region in thin film structures.

In response, Applicants respectfully assert that Zhang and Miyasaka do not teach, disclose or suggest ion doping into a channel region. In addition, Zhang states "the plasma doping is a simple and convenient doping method and can be used for purposes where high accuracy is not required." Moreover, it is known that doping into a channel region needs high accuracy because 1) the channel region has a lower concentration of the impurity element (such as boron) than that of source and drain regions and 2) the concentration of the channel region easily affects a performance of a thin film transistor. That is, doping into a channel region is quite different from doping into source and drain region. Therefore, Applicants respectfully assert that there is no motivation to combine Zhang and Miyasaka, which are related to the ion doping of the source and drain regions to Yamazaki modified by Silver, and Chang, which is related to the ion implantation of the channel region.

In general, in an IC fabrication process, impurity ions are implanted with an ion implantation apparatus. In the ion implantation apparatus, impurity ions are accelerated by

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means of an electrical field and then a mass separation is performed, so that only target ions are implanted. Therefore, the ion implantation apparatus is suitable for a doping process which needs high precision, such as in channel doping. However, such apparatus is very expensive and its throughput is relatively low. The implantation apparatus is not suitable particularly for mass-production of display device in which a large-size substrate has to be processed. (p. 2, ins. 8-17 of the specification)

In view of above, an ion doping apparatus without mass separation is preferably used since it can realize a process for adding impurity ions into a large-size semiconductor thin film. In the ion doping apparatus, source material gas which contains impurity ions is flowed into a chamber and plasmarized therein by a known method, thereby ionizing the contained impurity ions to be added to a crystalline semiconductor film. Although other ions (C, N, O etc.) other than the target ion species may be added into the film since no mass separation is performed, a satisfactory throughput can be realized in case of doping process for source and drain regions whose concentration of impurity ion is higher than that of other ions.


On the other hand, it has been difficult to precisely control the target ions of a minute amount to be doped into the channel forming region for controlling a threshold value, (p. 2, l. 17-p. 3, l. 6 of the specification). For example, comparing FIGS. 23-25 (an impurity element (boron) and C, N, O concentrations, the impurity element in the source gas: 0.1%) with FIGS. 27 and 28 (reference of C, N, O concentrations), it can be said that C, N, O are also added at the similar level as the impurity element through the doping process when the ion doping is performed using a source gas including 0.1% of an impurity element. (p. 2, l. 11 to p. 3, l. 24 of the specification) Further, Applicants discovered that the concentration of C, N, O was decreased by raising the concentration of the impurity element to 0.5 to 5%. (p. 11, l. 12 to p. 14, l. 4 of the specification and FIGS. 1 to 3). That is, Applicants discovered that the ion doping could be applied to channel doping. In other words, the ion doping without mass separation was generally not preferable because unwanted impurities such as C, N, O may be simultaneously added into a channel region. Hence, the presently claimed invention makes it possible to use the ion doping method for channel doping by reducing the introduction of the unintended impurities. At least for the reasons set forth above, unexpected results have been shown.

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Again, Applicants respectfully remind the Examiner that the requirements for establishing a *prima facie* case of obviousness, as detailed in MPEP § 2143 - 2143.03 (pages 2100-122 - 2100-136), are: first, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference to combine the teachings; second, there must be a reasonable expectation of success; and, finally, the prior art reference (or references when combined) must teach or suggest all of the claim limitations. Without recognizing the problem the presently claimed invention is solving, and without the motivation or suggestion to combine the prior art references, a *prima facie* case of obviousness has not been established in the pending rejections.

In view of the foregoing, it is respectfully requested that the rejections of record be reconsidered and withdrawn by the Examiner, that claims 1-3, 6-14 and 19-48 be allowed and that the application be passed to issue. If a conference would expedite prosecution of the instant application, the Examiner is hereby invited to telephone the undersigned to arrange such a conference.

Respectfully submitted,



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